

What is claimed is:

1. An optical amplifier having a polarization mode dispersion compensation function comprising:
 - a polarization control section that controls a polarization state of input signal light;
 - a polarization mode dispersion generation section that has an optical transmission medium which has birefringence capable of giving a differential group delay between orthogonal polarization mode components of the signal light controlled in said polarization control section, and which is doped with a rare earth element;
 - a pumping light supply section that applies pumping light capable of pumping said rare earth element, to the optical transmission medium in said polarization mode dispersion generation section;
 - a monitoring section that monitors a polarization mode dispersion generation state of the signal light output from said polarization mode dispersion generation section;
 - and a control section that controls said polarization control section so that polarization mode dispersion monitored in said monitoring section is reduced.
2. An optical amplifier having a polarization mode dispersion compensation function according to claim 1,
 - wherein said monitoring section monitors the power of signal light output from said polarization mode dispersion generation section, and
 - said control section controls said pumping light supply section so as to obtain a gain which makes the power of signal light monitored by said monitor section to be the power at the time of input or above.
3. An optical amplifier having a polarization mode dispersion compensation function according to claim 1,
 - wherein said monitoring section monitors the power of signal light output from said polarization mode dispersion generation section, and
 - said control section controls said pumping light supply section so that the power of signal light monitored by said monitor section is fixed to be constant at a previously set value.
4. An optical amplifier having a polarization mode dispersion compensation

function according to claim 1,

wherein said polarization mode dispersion generation section uses a polarization-preserving fiber as said optical transmission medium, and a light propagation region centering on a core of said polarization-preserving fiber is doped with a rare earth element.

5. An optical amplifier having a polarization mode dispersion compensation function according to claim 1,

wherein said polarization mode dispersion generation section uses an optical waveguide having birefringence which is formed on a substrate, as said optical transmission medium, and at least the optical waveguide on said substrate is doped with a rare earth element.

6. An optical amplifier having a polarization mode dispersion compensation function according to claim 5,

wherein said optical waveguide is an optical waveguide made of lithium niobate.

7. An optical amplifier having a polarization mode dispersion compensation function according to claim 5,

wherein said optical waveguide is an optical waveguide having variable refraction index, which is formed in a planar lightwave circuit.

8. An optical amplifier having a polarization mode dispersion compensation function according to claim 5;

wherein said polarization control section has an optical transmission medium of optical waveguide type doped with a rare earth element, and

said pumping light supply section supplies pumping light to each optical transmission medium of said polarization control section and said polarization mode dispersion generation section.

9. An optical amplifier having a polarization mode dispersion compensation function according to claim 1,

wherein said monitoring section comprises: a branching device which branches a part of the signal light output from said polarization mode dispersion generation section, as monitor light;

an output monitor which monitors the power and polarization mode dispersion generation state of the monitor light branched by said branching device; and

a pumping light interception device having a property for transmitting the signal light and intercepting the pumping light, which prevents leaked light of pumping light supplied to said polarization mode dispersion generating section from being input to said output monitor.

10. An optical amplifier having a polarization mode dispersion compensation function according to claim 9,

wherein said pumping light interception device is an optical filter, which transmits the signal light and intercepts the pumping light, arranged on an optical path of a main signal system positioned between said polarization mode dispersion generation section and said branching device, or on an optical path of a monitor system positioned between said branching device and said output monitor.

11. An optical amplifier having a polarization mode dispersion compensation function according to claim 9,

wherein said pumping light interception device is an optical isolator in which a loss is greater to the pumping light than to the signal light, arranged on an optical path of a main signal system positioned between said polarization mode dispersion generation section and said branching device.

12. An optical amplifier having a polarization mode dispersion compensation function according to claim 1,

wherein an optical filter having a property for transmitting the signal light and intercepting the pumping light and amplified spontaneous emission light generated accompanying amplification of the signal light in said polarization mode dispersion generation section, is provided on an optical path through which the signal light is propagated.

13. An optical amplifier having a polarization mode dispersion compensation function according to claim 1,

wherein when said polarization mode dispersion generation section is constructed by cascade connecting a plurality of optical transmission media having birefringence, a rare earth element is doped on at least the optical transmission media disposed on the signal light input side among said plurality of optical transmission

media, and

said pumping light supply section supplies forward pumping light to the optical transmission media doped with the rare earth element, of said polarization mode dispersion generation section.

14. An optical amplifier having a polarization mode dispersion compensation function according to claim 1,

wherein when said polarization mode dispersion generation section is constructed by cascade connecting a plurality of optical transmission media having birefringence, a rare earth element is doped on at least the optical transmission media disposed on the signal light output side among said plurality of optical transmission media, and

said pumping light supply section supplies backward pumping light to the optical transmission media doped with the rare earth element, of said polarization mode dispersion generation section.

15. An optical amplifier having a polarization mode dispersion compensation function according to claim 1,

wherein when said polarization mode dispersion generation section is constructed by cascade connecting a plurality of optical transmission media having birefringence, a rare earth element is doped on said plurality of optical transmission media, and

said pumping light supply section supplies forward pumping light to the optical transmission media disposed on the signal light input side, and supplies backward pumping light to the optical transmission media disposed on the signal light output side, among the plurality of optical transmission media doped with the rare earth element, of said polarization mode dispersion generation section.

16. An optical amplifier having a polarization mode dispersion compensation function,

wherein the optical amplifier of claim 1 is made one unit, and a plurality of units are disposed in parallel corresponding to a plurality of signal lights contained in a wavelength group, and common components of said units are integrated.

17. An optical amplifier having a polarization mode dispersion compensation function according to claim 16,

wherein a configuration where common monitor sections of said units are integrated, is provided with: an optical switch which selects any one of the signal lights output from the polarization mode dispersion generation sections of the respective units and outputs a part of said signal light, as monitor light; and an output monitor which is shared by each of said units, and which monitors the polarization mode dispersion generation state and optical power of the monitor light output from said optical switch.